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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/812,117	03/29/2004	Richard L. Elliott	2269-6990.2US	7596
24247	7590	12/01/2005	EXAMINER	
TRASK BRITT P.O. BOX 2550 SALT LAKE CITY, UT 84110			NOVACEK, CHRISTY L	
			ART UNIT	PAPER NUMBER
			2822	

DATE MAILED: 12/01/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

AK

<b>Office Action Summary</b>	Application No. 10/812,117	Applicant(s) ELLIOTT ET AL.	
	Examiner Christy L. Novacek	Art Unit 2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 29 March 2004.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 12-14 is/are allowed.
- 6) ☒ Claim(s) 1-8, 11, 15-17, 19 and 21 is/are rejected.
- 7) ☒ Claim(s) 9, 10, 18 and 20 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>8/24/04</u> . | 6) <input type="checkbox"/> Other: _____  |

### **DETAILED ACTION**

This office action is in response to the communication filed March 29, 2004.

#### ***Specification***

The disclosure is objected to because of the following informalities: Paragraph 0029 on page 10 of the specification recites, "The dielectrics include, but are not limited to oxides, nitrides, carbides, carbon nitrides, oxynitrides, doped or slightly doped monocrystalline or polycrystalline silicon, and their equivalents." However, doped or slightly doped monocrystalline or polycrystalline silicon are not dielectric materials.

Appropriate correction is required.

#### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 6 and 21 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 6 and 21 recite that the "insulation layer comprises a material selected from the group consisting of oxides, nitrides, carbides, carbon nitrides, oxynitrides, doped monocrystalline silicon or doped polycrystalline silicon." However, doped monocrystalline and polycrystalline silicon are not insulative materials. They are conductive.

#### ***Double Patenting***

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible

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harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 15-17, 19 and 21 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-4 of U.S. Patent No. 6,593,657. Although the conflicting claims are not identical, they are not patentably distinct from each other because all limitations recited in these claims are also recited in the claims of U.S. Patent No. 6,593,657. U.S. Patent No. 6,593,657 issued as a patent on July 15, 2003 *before* Application No. 10/812117 was filed on March 29, 2004. Therefore, U.S. Patent No. 6,593,657 is available as a reference for double patenting of the 10/812117 application.

Regarding claim 15 of the current application, claims 1-3 of the US 6,593,657 patent recite the limitations of a contact plug and metallization line structure comprising a semiconductor substrate having a contact surface thereon, an insulation layer having a contact hole therethrough extending to the contact surface on the semiconductor substrate, a plug comprised of a first metal and situated in said contact hole, the plug being electrically insulated by the insulation layer, and a metallization line comprised of a second metal, wherein the plug and the metallization line are electrically connected and have a substantially continuous composition gradient of a selected

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alloying element between the first metal and the second metal, wherein the contact surface has a first refractory metal silicide layer thereon in contact with a first end of said plug.

Regarding claim 16 of the current application, claim 3 of the US 6,593,657 patent recites the limitation of each of the first and second metals is selected from the group consisting of Al, AlCu, and AlSiCu, and wherein one of the first and second metals has a higher concentration of Cu than the other of the first and second metals.

Regarding claim 17 of the current application, claims 3 and 4 of the US 6,593,657 patent recite the limitation of the first and second metals have substantially the same composition.

Regarding claim 19 of the current application, claim 3 of the US 6,593,657 patent recites the limitations of a contact plug and metallization line structure comprising a semiconductor substrate having a contact surface thereon, an insulation layer comprising a doped oxide of silicon and having a contact hole therethrough extending to the contact surface on the semiconductor substrate, a plug comprised of a first metal and situated in the contact hole, the first metal being selected from the group consisting of aluminum and alloys thereof, the plug being electrically insulated by the insulation layer, and a metallization line comprised of a second metal, the second metal being selected from the group consisting of aluminum and alloys thereof, wherein the plug and the metallization line are electrically connected and have a substantially continuous composition gradient of a selected alloying element between the first metal and the second metal, wherein the contact surface has a first refractory metal silicide layer thereon in contact with a first end of the plug.

Regarding claim 21 of the current application, claim 3 of the US 6,593,657 patent recites the limitations of the insulation layer comprising oxide.

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-6 and 11 are rejected under 35 U.S.C. 102(b) as being anticipated by Lee et al. (US 5,355,020, cited in IDS).

Regarding claim 1, Lee discloses forming an insulation layer (32) situated on a semiconductor substrate (31), forming a contact hole in the insulation layer to expose a contact surface on the semiconductor substrate, and forming a single layer of metal (37) upon a top planar surface of the insulation layer, the single layer of metal substantially filling the contact hole and being in electrical contact with the contact surface on the semiconductor substrate (col. 10, ln. 57 – col. 11, ln. 62; col. 14, ln. 39 – col. 16, ln. 16). Lee does not specifically disclose that the single layer of metal has a substantially planar top surface. However, Lee does disclose that the single layer of metal is subjected to a heat treatment process wherein the single layer of metal is heated to a temperature up to its melting point whereby the metal flows into the contact hole to completely fill the hole (col. 11, ln. 25-54). Lee also discloses that when this same heating process is conducted on another metallic layer, the metallic layer becomes planarized (col. 16, ln. 6-16). Because Lee discloses that the heating process planarizes the second metal layer, it appears that the heating process also inherently planarizes the first metal layer. See *In re Swinehart*, 439 F.2d 210, 212-13, 169 USPQ 226, 229 (CCPA 1971) “where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in

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the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristics relied on ”); and *In re Fitzgerald*, 619 F.2d 67, 205 USPQ 594 (CCPA 1980) (a case indicating that the burden of proof can be shifted to the applicant to show that the subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 U.S.C. 102 or obviousness under 35 U.S.C. 103).

Regarding claim 2, Lee discloses that the single layer of metal comprises an alloy of a metal (col. 11, ln. 16-23).

Regarding claim 3, Lee discloses that the single layer of metal comprises a material selected from the group consisting of Al, AlCu, and AlCuSi (col. 11, ln. 16-23).

Regarding claim 4, Lee discloses that the single layer of metal comprises a material selected from the group consisting of AlSi and AlTi (col. 11, ln. 16-23).

Regarding claims 5 and 6, Lee discloses that the insulation layer comprises a material selected from the group consisting of doped silicon dioxide, BPSG and BSG (col. 11, ln. 3-6).

Regarding claim 11, Lee discloses forming a single layer of metal by using a PVD deposition process (sputtering) (col. 15, ln. 17-19).

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (US 5,355,020) in view of Sahota (US 5,840,623).

Regarding claim 7, Lee discloses depositing the single layer of metal upon the top surface of the insulation layer, the single layer of metal having a selected thickness, treating the semiconductor substrate in an environment of a selected pressure range and a selected temperature range so as to cause the single layer of metal to substantially fill the contact hole, heat treating the single layer of metal, and forming a metal line having a selected shape from the single layer of metal (col. 10, ln. 57 – col. 11, ln. 62; col. 14, ln. 39 – col. 16, ln. 16). Lee does not specifically disclose that the single layer of metal has a substantially planar top surface. However, Lee does disclose that the single layer of metal is subjected to a heat treatment process wherein the single layer of metal is heated to a temperature up to its melting point whereby the metal flows into the contact hole to completely fill the hole (col. 11, ln. 25-54). Lee also discloses that when this same heating process is conducted on another metallic layer, the metallic layer becomes planarized (col. 16, ln. 6-16). Because Lee discloses that the heating process planarizes the second metal layer, it appears that the heating process also inherently planarizes the first metal layer. Lee does not disclose planarizing the insulation layer to form the top surface of the insulation layer. Like Lee, Sahota discloses forming metallization interconnect structures in an insulation layers. Sahota discloses that it is conventional in the art to planarize the surface of the insulation layer (col. 1, ln. 6-36). At the time of the invention, it would have been obvious to one of ordinary skill in the art to planarize the insulation layer of Lee because it is conventional in the art to planarize the insulation layer in order to prevent photolithography problems.



Regarding claim 8, Lee discloses patterning and etching the single layer of metal into the metal line having the selected shape (col. 16, ln. 23-32).

***Allowable Subject Matter***

Claims 9, 10, 18 and 20 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 12-14 are allowed.

The primary reason for the indication of the allowable subject matter of claims 9 and 10 is the inclusion therein, in combination as currently claimed, of the limitation of forming a silicide layer on the contact surface made of silicon, forming a metal nitride layer on the sidewall of the contact hole such that it is *in contact* with the insulation layer, and depositing a single layer of metal such that it is in contact with both the silicide layer and the metal nitride layer. This limitation is found in claims 9 and 10 and is neither disclosed nor taught by the prior art of record, alone or in combination.

The primary reason for the indication of the allowable subject matter of claims 18 and 20 is the inclusion therein, in combination as currently claimed, of the limitation of a plug and a metallization line wherein the plug and metallization line have a substantially continuous composition gradient of an alloying element between them. This limitation is found in claims 18 and 20 and is neither disclosed nor taught by the prior art of record, alone or in combination.

The following is an examiner's statement of reasons for allowance:

The primary reasons for the allowance of claims 12-14 is the inclusion therein, in combination as currently claimed, of the limitations of forming a silicide layer on the contact

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surface, forming a metal nitride layer on the sidewall of the contact hole such that it is *in contact* with the insulation layer, and depositing a single layer of metal such that it is in contact with both the silicide layer and the metal nitride layer. These limitations were found in claims 12-14 and are neither disclosed nor taught by the prior art of record, alone or in combination.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

### ***Conclusion***

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

Komatsu (US 5,719,083) discloses forming a contact hole in an insulation layer and depositing a single layer of an aluminum alloy metal in the contact hole to form a contact plug and metallization line (col. 12, ln. 36 – col. 13, ln. 46).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christy L. Novacek whose telephone number is (571) 272-1839. The examiner can normally be reached on Monday-Thursday and alternate Fridays 7:30 - 5:00.

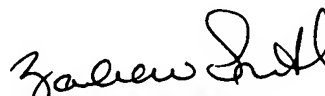
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on (571) 272-2429. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

CLN

November 28, 2005

  
**ZANDRA V. SMITH**  
**PRIMARY EXAMINER**  
11/28/05